

Evaluation Monitoring for Stormwater Runoff Water Quality Impact Assessment and Management

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Problems with Conventional Stormwater Runoff Water Quality
Monitoring in Defining Pollution and Pollutants

Need for, and Characteristics of, Evaluation Monitoring

Upper Newport Bay Tributary Toxicity Studies

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Orange County Area Highway Stormwater Runoff Chemical Characteristics Caltrans District 8 & 12 (1994)

Parameter	Detection Units	Chapman Ave (I-5, PM34.7)	Walnut Ave (SR-55, PM14.2)
Total Suspended Solids	mg/l	85	100
Total Dissolved Solids	mg/l	12	12
Chemical Oxygen Demand	mg/l	42	24
Oil and Grease	mg/l	5.3	2.5
Fecal Coliform	ml	<2/100	50/100
pH	unit	7.0	9.1
Total Residual Chlorine	mg/l	0.45	<0.20
Nitrate	mg/l	0.43	0.37
Nitrite	mg/l	0.051	0.042
Ammonia	mg/l	1.3	0.9
Total Kjeldahl Nitrogen	mg/l	0.89	1.4
Total Phosphorus	µg/l	120	130
Dissolved Phosphorus	µg/l	130	120
Sodium	µg/l	3000	1500
Cadmium	µg/l	<5	8
Copper	µg/l	24	22
Lead	µg/l	48	160
Chromium	µg/l	<10	<10
Zinc	µg/l	180	140
Iron	µg/l	3400	3400
Nickel	µg/l	<32	<32
Magnesium	µg/l	1300	1300



Conventional Water Quality Monitoring - Management Approach "Compliance Monitoring"

- Monitor Concentrations of Selected Regulated Chemicals in Runoff Water
- Compare Monitoring Results to Accepted Discharge Limits and Ambient Water Quality Standards
- If "Excessive" Concentrations (Loads) Found in Discharge, Reduce Discharge of Chemical Constituents to Achieve Regulatory Compliance with Water Quality Standards

Focus of Conventional Approach Is Control of Chemicals in Discharge to Achieve Allowed Concentrations (Loads)

Conventional Chemical Approach Not Technically Valid for Stormwater Runoff - Leads to Over-Regulation and Waste of Funds and/or Under-Regulation of Unregulated Constituents

Purpose of Monitoring

Compliance Monitoring to Meet Discharge Permit Limitations

Water Quality Problem Definition
Water Quality/Use-Impairment

Not a List of Chemical Concentrations Relative to Water
Quality Standards

Must Focus Monitoring Resources on Chemical Impacts, Not
Chemical Concentrations

Evaluation of the Impact of Potentially Toxic Chemicals

Given 20 µg/L of Cu in Discharge/Runoff with the Water
Quality Standard of 15 µg/L:

What Can Be Said about the Water Quality/Use-
Impairment of the Receiving Waters Due to the Cu in the
Discharge/Runoff?

Nothing

Need Site-Specific Evaluations of Possible Cu Impacts or
Water Quality

**Same Type of Problem Exists with Respect to Evaluating
the Water Quality Significance of a Cu Exceedance of a
Water Quality Standard in Ambient Waters**

What Can Be Said about the Water Quality Impacts of Cu in a
Waterbody at 20 µg/L When the Standard Is 15 µg/L?

Potential Water Quality Impact Due to Cu Toxicity

Impact Cannot Be Assessed Based on Chemical
Measurements

Must Use Biological Effects-Based Approaches i.e.
Toxicity Measurements to Determine if the Cu Is Toxic

Evaluation of the Impact of Potentially Bioaccumulatable Chemicals

Given Hg at 30 ng/L in a Waterbody with a Hg Bioaccumulation-Based
Standard of 12 ng/L:

What Can Be Said about the Amount of Bioaccumulation of Hg in
Fish?

All That Can Be Said Is That Hg at 30 ng/L Could Bioaccumulate
to Excessive Concentrations in Fish

Many Examples Where the Predicted Bioaccumulation Does Not
Occur

Need Site-Specific Fish Tissue Analysis to Determine if Excessive
Hg Bioaccumulation Is Occurring

US EPA Water Pollution Control Program for Toxicity and Bioaccumulation Focused on Chemical Concentrations

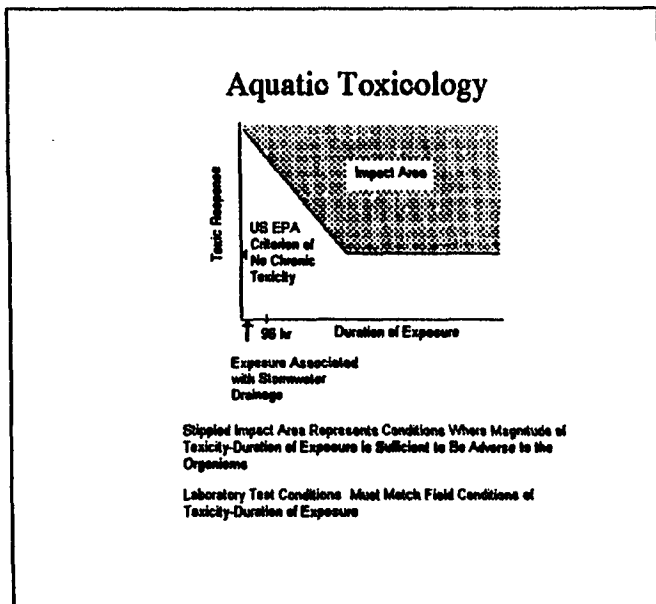
Water Pollution Control Program Should Be Focused on Chemical
Impacts, Not Chemicals

Current Approach Bureaucratically Simple to Administer, but Often
Technically Invalid

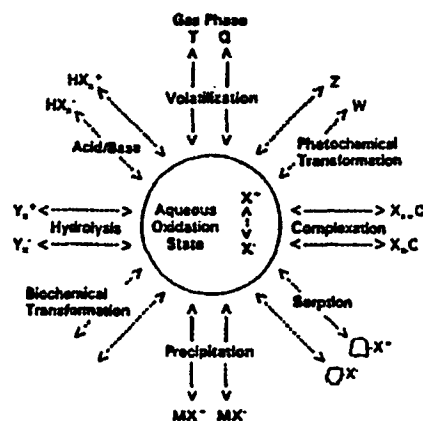
Tends to Over-Regulate Those Constituents for Which There Are
Water Quality Criteria/Standards

Does Not Address the Vast Arena of Unregulated or Under-
Regulated Chemicals Such as the Organophosphate Pesticides

Toxicity - Duration of Exposure Relationship



Aquatic Chemistry of Chemical Contaminants



Distribution Depends on Kinetics & Thermodynamics of Reactions in a Particular Aquatic System

Each Chemical Species Has Its Own Toxicity Characteristics
Many Forms Are Non-Toxic

Factors That Must Be Evaluated in Translating Stormwater Runoff Concentrations of Potentially Toxic Chemicals to Receiving Water Aquatic Life Impacts

Runoff Waters

Concentration/Duration Profile of Potential Pollutants during Runoff Event

Analytical Chemistry of the Measurement Procedures Used

Forms of the Chemical Constituent That Are Measured in the Chemical Test Relative to the Forms That Are Adverse to Aquatic Life

Hydrologic Characteristics of the Runoff Event

Receiving Waters

Physical Factors

Currents, Tides, Mixing/Dispersion, Density Differences between Runoff and Ambient Waters

Transport/Advection

Temperature, Sunlight Penetration, etc.

Chemical Factors

Ambient Water Concentration of Toxic/Available Forms of Constituent

Aquatic Chemistry

Chemical Kinetics and Thermodynamics of Possible Chemical Transformations/Reactions

Other Chemicals in Receiving Waters

Biological Factors

Types of Organisms Present and Their Sensitivity to the Chemical of Concern

Locomotion, Diel Migration, Attraction/Avoidance to the Discharge

Concentration of Chemical/Duration of Exposure Relationship in the Ambient Waters for Potentially Impacted Organisms Relative to the Critical Concentration/Exposure Relationship for the Organisms Exposed

Importance of the Impacted Organisms to Water Quality and the Ecosystem/Ecosystem Health

Types of Potential Water Quality Impacts Use-Impairment - Pollution

- Drinking Water Use-Impairment - Surface and Groundwater
- Aquatic Life Toxicity in Water Column and/or Sediments
- Excessive Bioaccumulation - Human Health &/or Wildlife
- Suspended Sediment - Turbidity - Siltation - Habitat Impacts
- Excessive Fertilization/Eutrophication - Nutrients - N & P
- Pathogenic Organism Indicators
- Low Dissolved Oxygen
- Aesthetics - Litter, Debris, Oil Sheen, etc.

Questions That Should Be Addressed

- Is There Significant Toxicity in the Receiving Waters That Is Associated with Runoff Events?
- Are There Closed Shellfish Beds, Swimming Areas, etc.?
- Is There Excessive Algal/Aquatic Weed Growth?
- Is There Litter and Debris?
- Do the Fish and/or Shellfish Contain Excessive Concentrations of Hazardous Chemicals?
- Is the Water Turbid? Is There Shoaling, Burial of Spawning Areas, Shellfish Beds, etc.?
- Are Domestic Supplies Experiencing Treatment Problems, Excessive Costs?

Define the Most Important Water Quality Use-Impairments in the Receiving Waters That Are Potentially Due to Stormwater Runoff

GUIDANCE FOR CONDUCTING WATER QUALITY STUDIES

for Developing Control Programs for Toxic Contaminants
in Wastewaters and Stormwater Runoff

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Evaluation Monitoring Approach for Water Quality Management

Focus Monitoring Resources on:

- Evaluation of Real Water Quality Use-Impairments in Receiving Water for Stormwater Runoff
- Determine the Specific Cause(s) of Use-Impairment
- Determine Source(s) of Constituents Responsible for Those Use-Impairments
- If Urban & Highway Stormwater Runoff Is Significant Source of Specific Constituent(s) Responsible for the Use-Impairment, Control Pollutants at the Source

If Not Possible, Develop Site-Specific BMP's to Control Pollution to Maximum Extent Possible

Will Result in Significantly Different Type of BMPs Than Typically Used Such as Detention Basins & Filtration

Detention Basins & Filtration Useful Only Where Excessive Erosion Causes Water Quality/Use-Impairment Due to Siltation and/or Turbidity

Basic Engineering Approach:

Find the Problem & Solve It in a Technically Valid, Cost-Effective Manner

Focus Stormwater Water Quality Management on Impacts of Chemicals - Not on Chemicals That May Be Adverse to Water Quality at Some Location for Some Sources

Evaluation Monitoring Is Conducted in a Watershed-Based, Technical Stake-Holder-Driven Program

Evaluation Monitoring Focuses on Using Aquatic Chemistry, Aquatic Toxicology, and Water Quality Information to Define & Manage Impacts of Urban & Highway Stormwater Runoff